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Original Article

High Tibial Osteotomy with External Fixator in the Varus Gonarthritic Knee

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Abstract. High tibial osteotomy is a simple and safe method to correct the varus gonarthritic knee. Numerous follow-up studies have demonstrated that this procedure gives satisfactory functional results for 10-15 years after surgery, above all if a precise valgus hypercorrection of 8°-10° is carried out. The present study attempts to deal with another, less discussed topic: evaluation of the efficacy of external fixation after osteotomy synthesis with respect to the most common plate and screw synthesis as well as to the Insall procedure.

Key words: tibial osteotomy, external fixator, gonarthrosis

Introduction

High tibial osteotomy is a simple and safe method to correct the varus gonarthritic knee (VGK) (1). Numerous follow-up studies have demonstrated the reliability of this procedure over time. Insall et al. (2) evaluated 95 high tibial osteotomies and noted excellent or good results in 95% of the cases after 2 years, in 85% after 5 years and in 63% after 9 years. Coventry et al. (3) evaluated 87 tibial osteotomies, calculating the time from osteotomy and the recurrence of pain in the medial compartment or the implementation of an arthroplasty: they confirmed an 87% survival rate at 5 years and a 55% survival rate at 10 years. Studies with a follow-up greater than 10 years are not so numerous. One of them conducted by Aglietti et al. (1) had an average follow-up of 15 years and, in agreement with the preceding studies, demonstrated progressive deterioration of clinical and radiographic results over time. Results were satisfactory in 73% of the knees with a follow-up of 10-14 years and in 40% of the knees with a follow-up >20 years, with an average value at 15 years, of 55%. Analysis of the results of these studies demonstrates that high tibial osteotomy to correct the VGK provides satisfactory functional results for 10-15 years from surgery. The correct indications for this method include treatment of unicompartmental gonarthrosis of the knee in patients <65 years old if that they do not have knee instability and they have not undergone meniscectomy.

The degree of correction of the VGK has also been widely discussed. Valenti et al. (4) have shown clinical and radiographic results of 100 high tibial osteotomies on the VGK with an average follow-up period of 11 years, evidencing that the best results in the group were the ones over-corrected (8°-10° valgus). The deformity tends to decrease over time, causing recurrence of pain in the medial compartment of the knee, worsening gonarthrosis progression. It is for this reason that the VGK must be hypercorrected.

At this point there is no longer any controversy concerning indications for the performance of high tibial osteotomy, just as the influence of bone erosion has been widely studied, from lateral subluxation and ligament laxity on the final result and the progression of arthropathy over time (5). This study, instead, at-

tempts to deal with a different, less widely discussed topic than the above, that is, to evaluate the efficacy of external fixation in osteotomy synthesis with respect to the most common plate-screw synthesis and the Insall procedure (6).

Materials and Methods

From 1996 to 2000, at the Orthopaedic Clinic of the University of Siena, 18 high tibial osteotomies for VGK were carried out on 18 patients: 16 women and 2 men, average age 56 years, range 39-65 years. In 11 patients the right knee was affected, in 7 the left knee was involved. None of the patients had previously undergone invasive procedures on the knee. The level-stage of preoperative gonarthrosis was evaluated by use of the Ahlback classification (7) that divides the cases into 5 progressively worsening groups. In our series, 10 patients were grade 1, 6 patients were grade 2 and 2 patients were grade 3. We did not carry out any tibial osteotomies on patients that were classified as Ahlback grade 4 or 5.

Indications for surgery were: internal unicopartmental gonarthrosis with a healthy external compartment; age no greater than 65 years; no preceding meniscectomy, either partial or total within the internal compartment, no instability, no obesity.

Preoperative planning was based on the radiographs of the lower limbs carried out under load-bearing (Fig. 1). The profile of the femur and the tibia were designed on transparent paper and the center

Figure 1. A) Preoperative radiograph with patient in reclining position. B) Radiograph with patient bearing weight.

of the femoral head and the tibiofibular articulatio were indicated as reference points. The osteotomy line was traced on the drawing with a distal-proximal and medio-lateral obliquity of about 15° with respect to the surface of the tibial plateau, taking care to position it exactly above the upper-medial margin of the great tibial tuberosity, and to interrupt it 5 mm from the lateral edge of the external half of the tibial plateau. The osteotomy line was then created so as to be able to put the portion of the distal tibia into a valgus position in relation to it and to calculate the degree of the wedge necessary to correct the deformity with a hypercorrection of 8°. This value is reached when the mechanical axis, brought from the center of the femoral head to the center of the tibial joint meets the articular surface of the tibia at about 60% of its width, with a value of 0% given to the medial margo and a value of 100° given to the lateral margo.

A Castaman angular external fixator was applied to all patients, with the clamping elements positioned perpendicularly to each other. The proximal element is parallel to the articular surface of the tibia and creates a locking system that, when opened, allows hemicallotaxis to act on the distraction mechanism. The distal element is parallel to the tibial shaft (Fig. 2). Surgery is carried out in ischemia thanks to a tourniquet tied around the upper leg. Under fluoroscopy two half-screws are fixed in the proximal epiphyseal portion of the tibia and two in the shaft. A Kirschner wire is then inserted disto-proximally and medio-laterally, following the direction of the osteotomic line drawn during the preoperative planning stage. After execution of a medial longitudinal incision, the osteotomy is done with an electric saw and osteosite, following the Kirschner wire. The subsequent phase of the operation consists in verifying the width of the osteotomy wedge, whose edges must be pressed together when the procedure is terminated comes to the ends.

Weight-bearing is allowed with the aid of crutches on 2 day post-operative. As soon as the patient begins to walk, progessive hemicallotaxis is carried out through action on the distraction mechanism of the external fixator (Fig. 3). This procedure is called hemicallotaxis or hemicompactomy. The first distractive maneuver is carried out in the out-patient clinic: the patient is taught how this should be done daily. One daily correction is prescribed until the desired correction is reached. Periodic full-length radiographs of the lower limb are carried out to control the degree of correction obtained.

At the end of the hemicallotaxis process, new radiographs are taken, under load-bearing by the lower limb so as to compare the results obtained with those planned for preoperatively (Fig. 4). If discrepancies are found, it will be necessary to act further on the distraction mechanism until the planned results coincide with those obtained.

Subsequent radiographic and clinical controls are carried out every 30 days. The external fixator is removed 4-5 months after surgery when the formation of a bony callus at the osteotomy confirmed (Fig. 5).

Figure 2. Castaman angular external fixator.

Figure 3. Radiograph with patient bearing weight 30 days postoperative.

Figure 4. Radiograph 60 days postoperative.

Results

All patients were followed clinically and radiographically with an average follow-up of 4.6 years (range: 8 months – 7 years). The clinical results were evaluated by means of the Hospital for Special Surgery Knee Service Rating System, which assigns 100 points to a normal knee. This point system is divided as follows: 30 points for pain (at rest and during walking), 22 points for functionality (walking long distances, climbing stairs), 18 points for range of motion (ROM), 10 points for muscular strength, 10 points for permanence of contracture in flexion and 10 points for instability. The results were excellent or good in 15 patients (85%), satisfactory in the remaining 3 patients. Sixty-five percent of the patients did not have pain at rest or while walking. No patient has, up to the present, required arthroplasty. Postoperative radiographic results have demonstrated the need to modify the osteotomy opening in 7 patients (40%); all patients, after bone consolidation, had a valgus hypercorrection of about 8%. The patients with longer follow-up have, not evidenced up to now, substantial modifications in the femoral-tibial angle. Four patients had postoperative complications: 2 had superficial infections at the screw access site, resolved

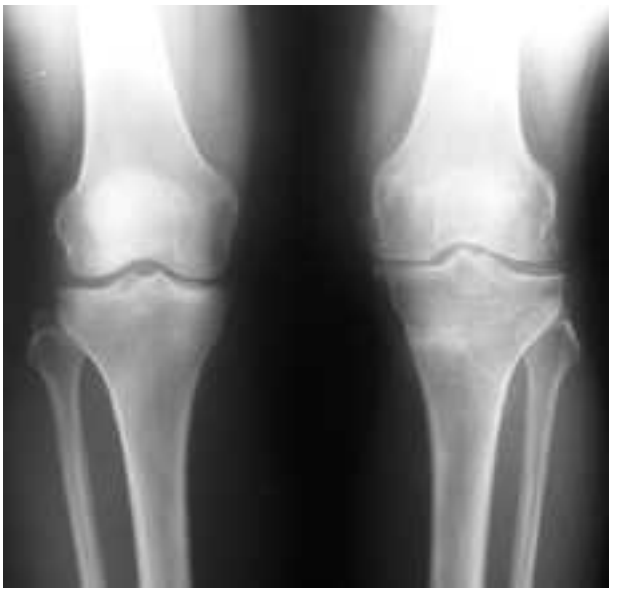

Figure 5. Radiograph 1 year after removal of external fixator.

by removal of the screws, one had a deep vein thrombosis and one had delayed osteotomy consolidation.

Discussion

Implementation of a high osteotomy with a medial wedge in the varus knee with internal unicompartmental gonarthrosis allows improvement of weight distribution on the joint surfaces and corrects femoral–tibial malalignment. Many authors have demonstrated the validity of this method over time (1-3), above all if the correction is precisely carried out (4). Although in our series, follow-up has been relatively short-term, the clinical and radiographic results are comparable to those of other authors. While not widely practiced, the use of an external monoplane-monolateral external fixator as the synthesis element for the osteotomy presents a number of advantages over the utilization of plates and screws or the Insall procedure. The eventual discrepancy between the desired correction and the actual correction obtained can be cancelled by regulating the external fixator - with no trouble to the patient – to obtain values assuring the best clinical results over time. The stability of the fixator allows early walking, limiting the discomfort of the initial prohibition of weight-bearing that must be prescribed in the case of plates, or the aftermath of immobilization in plaster necessary with the Insall procedure. After consolidation, no synthesis device remains at the osteotomy site. The presence of the base element of the external fixator is, in the end, the only temporary cause of discomfort to the patient.

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